Determinants of Return on Oil and Gas Stocks in Canada and the US: A Micro & Macro Analysis

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN FINANCE

In the Master of Science in Finance Program
of the
Faculty
of
Business Administration

SIMON FRASER UNIVERSITY

Fall 2014

Approval

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Degree: **Master of Science in Finance**

Title of Project: Determinants of Return on Oil and Gas Stocks in Canada and the US: A Micro & Macro Analysis

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Abstract

This paper takes a look at the determinants of oil and gas sector returns for US and Canadian companies. We examine returns during the period of 2001 to 2013 using a multifactor model to determine significant return factors. Our model incorporates both macro factors as well as firm specific micro factors. We also incorporate an analysis of the effect of the financial crisis on returns. Finally we briefly examine hedging in this sector and determine through our model if firms hedge against oil and gas price fluctuations. Our results suggest that profit margin and price to book ratio are positively related to oil and gas stock's returns, while book leverage is negatively related with stocks' returns. Market capitalization does not have any effect on stocks' return. In terms of macro variables, the returns are positively linked with the market return, oil price and gas price, and negatively with GDP, interest rate, Crisis and, for Canadian companies, exchange rate.

Acknowledgements

We wish to extend our sincere thanks to Dr. Christina Atanasova for her time, invaluable guidance and prompt feedback. We would also like to thank Dr. Evan Gatev for agreeing to be the second reader and for his time and helpful comments. Finally we wish to acknowledge the Beedie School of Business for providing a conducive atmosphere and outstanding facilities for learning and for conducting our research.

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I. Introduction

Oil and gas prices have been volatile in the past 13 years, they are seen to be affected by global factors such as political crises and threat of war in the Middle East as much as supply and demand. Our paper takes a look at the factors that determine the return on stocks in Canadian and US oil and gas sectors from 2001 to 2013. This time period is chosen because there is a very limited coverage of the investigated topic in the more recent years. Moreover, it allows to examine the effects of the financial crisis on returns for this sector. A unique perspective that our paper takes a look at is the effect of both macro and micro variables in determining oil and gas sector returns. We also explore if the companies in the sample are involved in hedging their exposure to commodity prices.

The oil and gas sector includes all components of the industry; that is upstream, midstream and downstream. The upstream refers to those firms that are involved into exploration and production of oil and natural gas, also called the E&P sector. This is usually the most risky part of oil and gas sector due to uncertainty involved in finding oil or gas deposits and the commercial viability in extracting them. Midstream involves transportation, storage and wholesale marketing of the extracted oil and gas. In case of natural gas the transportation is usually through pipelines to utility companies. Downstream sector involves marketing and distribution of products derived from natural gas such as petroleum, diesel, liquefied petroleum gas etc.

The US accounts for more than 18 million barrels of oil consumption per day. That is 8 million barrels more than second place China. US consumption has come down from highs of more than 20 million during the middle of 2000's. Canada consumes less than 2.28 Million barrels per day however its GDP is only 11% of the US. It still is one of the top ten countries in the world in terms of oil consumption.

The rest of this paper is structured as follows: Section II contains an overview of existing literature in the field. Section III provides the description of the Data used in this paper as well as Methodology applied in our analysis. Section IV provides and analyses the result of the present research. Finally, section V summarizes the study and draws conclusions.

II. Literature Overview

The idea of decomposing return on stocks into various factors has been of great interest since the 60's, when William Sharpe published his seminal paper which introduced the Capital Asset Pricing Model (1964) which had market return as a single explanatory factor. The next significant development belonged to Fama and French (1992) who added factors of size and relative valuation to the market model proposed by the CAPM. A great deal of research using the above model has been done for the return in the energy sector. Particularly, Kavussanos and Marcoulis (1997) show that market return (estimated by S&P 500) has the largest effect on prices of oil refining companies, while market capitalization and asset to book value ratio have relatively small positive effect. The current paper will be investigating the abovementioned relationships between returns on oil and gas stocks with firms size', their relative valuations and of course, the market return among other variables.

A great number of multifactor models have been developed in an attempt to further explain the return in the oil and gas sector. The research conducted for North American markets is of particular interest for our paper. The cornerstone work on determinants of returns for Canadian oil and gas companies' stocks was done by Perry Sadorsky (2001). He estimated the influence of macro variables ("risk factors" in the original paper) on returns of oil and gas Canadian companies' stocks'. The data analysed in the paper covers the interval from last quarter of 1983 to the last quarter of 1999. Variables such as crude oil prices, interest rates and CAD/USD exchange rate were found to have 'large and significant" effect on the dependent variable. The empirical results of the 2001 paper show that both market and oil price are positively related to returns on companies' stocks, while exchange rate and term premium are negatively related with them. Below we will see that the present research leads to very similar results for these variables.

Sadorsky explains that due to the cyclical nature of the oil and gas sector, "uncertainty about price volatility is a constant concern" for the companies operating in this industry. This concern could be solved by hedging the exposure to oil price, but for the time period analysed in that paper not many companies "realized the benefits of energy risk management", as Sadorsky noted. The present paper is aimed to test whether Canadian and US companies hedge their oil and gas price exposure in more recent years (namely from 2001 to 2013 inclusive). Sadorsky also predicted that

Canada's net exports of oil and gas would increase in the following 10 years, and therefore Canadian oil and gas firms would have greater exposure to the exchange rate risk. Indeed, the exports of oil and gas from Canada to the US increased to almost 97% of total Canadian exports of oil and gas in 2013 (US Energy Information Administration), and the present paper examines the effect of exchange rates on returns of Canadian stocks below. Finally, Sadorsky (2001) finds that oil and gas stocks move with the economic cycle and therefore they are not a good hedge against inflation.

The next prominent paper is by Boyer and Filion (2004). It analyses the returns on Canadian energy stocks for the time period between March 1995 and September 2002. The authors find that the return of Canadian energy stocks is positively associated with the Canadian stock market return, appreciations of crude oil and natural gas prices and with growth in internal cash flows and proven reserves. Negative relationship with interest rates was found. Separate analysis of integrated oil and gas companies and independent producers of oil and gas is performed in their paper.

In contrast to Boyer and Filion who analyse the industry specific variables such as proven reserves of oil and gas and drilling success, we focus on companies' fundamental variables, looking at oil and gas stocks returns from a financial analysis perspective.

Dayanandan and Donker (2010) investigate the relationship between firms' performance measured by the return on equity (ROE) and oil prices, capital structure and market capitalization. They use a sample of North American oil and gas companies on a time span from 1990 to 2008. The paper establishes that commodity prices (namely oil and gas) are the main explanatory variables of accounting measures of performance in the industry. The accounting variables investigated in their paper are both found to be significant: greater total assets are associated with higher ROE, while higher financial leverage leads to lower ROE. Also, their research establishes the negative relationship between recent financial crisis of 2007 and 2008 and the returns on oil companies' stocks. The earlier market disturbances (such as Asian financial crisis and 9/11), on the other hand, were found not to significantly impact the performance of oil and gas companies.

III. Data and Methodology

Data

The purpose of this paper is to analyse more recent market data than in previous studies. One of our aims is also to test the effect of the global financial crisis. Therefore the timespan from 31st January 2001 to 31st December 2013 has been chosen. There are 52 publicly traded oil and gas companies in the sample: 32 from the United States and 20 from Canada. We used specific criteria to pick companies. First, data availability for the whole period of the analysis, namely from the first quarter of 2001 to the last quarter of 2013. There is a trade-off between including less years in the analysis and hence being able to investigate more companies and using longer period, but with relatively less companies. By choosing longer period of observations we had to forgo companies that have either been acquired, merged, or possibly left the industry during the analysed period, which is quite common in the oil and gas sector, especially in Canada. There might be a downside to this strategy in terms of survivorship bias, however on the scale of 13 years their effect might be quite small. More importantly, on the upside, this analysis is more likely to reflect true relationships between variables as it is performed under different market conditions (from the rapid economic growth in the early 2000s to the great recession in 2008 and the subsequent recovery). Second criteria was the size of the company in terms of market capitalization of minimum 500 million USD or CAD (depending on company's country of origin). We found that companies with market capitalization below the above threshold are often private or recently established.

All the data is gathered from Bloomberg and is quoted in USD, unless specified otherwise. The full list of the companies with the respective market capitalization (in million) as of November 2014 is provided in the Appendix.

We start our model with a simple market model, including the excess return on a market portfolio. S&P 500 index is used as a market proxy, and 1-month T-bill rate is used as a default free rate. The log of market price in excess of T-bill, denoted R_M below rather than price is used in our analysis. A strong positive relationship with the dependent variable is expected. Mean returns and their standard deviations for the sample and market returns are provided below. One can notice that the mean of oil and gas stocks' returns is higher than that of the market.

Table 1. Mean and Standard Deviation for an average sample return and return on S&P 500

	Sample	Market (S&P 500)
Mean Return	0.0067	0.0008
St. Dev.	0.1169	0.0455

Next, we include a set of systematic and company-specific variables in our model. Systematic (macro) variables are common for all the companies in the sample, while specific (micro) are unique characteristics for each individual company.

Systematic or macro variables include oil and gas prices, inflation, US GDP, interest rate and exchange rate between US and Canadian dollars. The detailed explanation of every variable follows.

WTI futures price and NYMEX natural gas futures price are used as oil and gas prices, respectively. The use of futures prices in both cases is consistent with the previous research, as spot oil and gas prices are highly volatile and do not always reflect the real price of a commodity. All variables are quoted in USD, which eliminates exchange rate distortions. Log of oil and gas futures prices are denoted as R_{oil} and R_{gas} respectively. The positive relationship between stocks' returns and oil and gas returns is expected. The mean and standard deviation for R_{oil} and R_{gas} is provided below.

Table 2. Mean and standard deviation of returns on oil and gas

	Oil	Gas
Mean Return	0.0083	-0.0054
St. Dev.	0.09	0.16

An average return on gas is negative, which reflect the fact that gas price in the US has been declining in the past 10 years. This is explained by the increasing supply of gas, with demand staying relatively constant over the mentioned time period.

In order to measure the commodity cycle, which affects the oil market greatly, real US GDP, calculated Quarter on Quarter and annualized, is used as proxy. It is denoted GDP below. An increase in GDP is expected to on average increase oil and gas stocks' returns.

Next, interest rate (Int) factor reflects the term premium, and is calculated as the difference between 10 year Treasury Bond yield and 3 month T-bill yield. The data on these variables are obtained from St Louis Federal Reserve. Term premium aims to indicate the present state of the economy, as it is positively linearly correlated with economic growth, as pointed out in Sadorsky (2001). Oil and gas industry is capital intensive and typically highly leveraged, therefore higher term premium translates into higher cost of borrowing, so negative relationship between interest rates and sample's returns is one possible outcome. On the other hand, it has been found that short term interest rates are negatively correlated with the stocks returns in both Canada and the US (Mittoo, 1992). Boyer and Filion (2004) also find that stocks' returns are negatively dependent on the term premium. The overall effect of the term premium is likely to be negative.

The exchange rate (ER) variable stands for the growth of CAD/USD exchange rate. It is only estimated for Canadian companies, as Canada is the net exporter of oil to the US, but US does not solely depend on Canada in terms of import as has been mentioned above. The effect of ER is ambiguous, as we will discuss below.

The set of micro variables in this analysis includes companies' market capitalization, price to book ratio, degree of financial leverage and profit margin.

Market capitalization is calculated as the product of the number of shares outstanding of company i multiplied by the last price of company's i stock for that period. Market capitalization reflects the size of the company and has been proven to be a factor that determines the return in certain samples in the pasty (Fama French 1993, 1996). However the following research on different data found the size effect to be reverse and in most cases insignificant. Therefore no exact relationship with the sample's returns is expected. The log of market capitalization is used in our analysis and is further denoted as $MCap_i$.

Price to book (PB_i) ratio is calculated as market price of equity *i* divided by the book value of equity and represents market's valuation of the stock relative to its intrinsic value. This factor has also been found significant in explaining stocks returns (Fama French 1993, 1996). For capital-intensive oil and gas industry book value of assets is an important indicator, and hence price to book is worth investigating. The positive relationship with returns is expected, since Canadian and US stock markets are assumed to be efficient in at least semi-strong form, and hence embed the information in prices on its arrival.

Next company specific variable is the degree of financial leverage ($FLev_i$) . This ratio is calculated as Total Average Assets of company *i* divided by its Average Total Common Equity. This reflect the book value of leverage. Kavussanos and Marcoulis (1997) showed that leverage, whether measured using accounting or market values, has a significant impact on stock prices. However, the effect varies depending on the variable used. Fama and French (1992) found that *market* leverage on average affects returns positively, while *book* leverage affects returns negatively. Higher book financial leverage is an indicator of fundamental risk that it associated with company's equity, which in turn, is reflected in lower market price. Since the book value of equity is used in this paper, the expected effect on returns in negative.

Profit Margin (PM_i) is calculated as Net Income / Sales in percentage terms. Profit Margin serves as a measure of profitability of the company, and more profitable companies in terms of income are expected to have higher return on stocks as well.

In terms of frequency of our data, variables such as stocks price and market capitalization, market index price, interest rate, oil and gas prices and exchange rate have monthly observations. Macro variable of GDP is quarterly. Accounting variables such as profit margin, degree of financial leverage and price to book ratio are annual.

$Crisis_t$ is a dummy variable, which represent the Global Financial Crisis of 2008. This variable takes values of 1 for all months between July 2008 and June 2009, and zero otherwise. The chosen period for crisis represents the months of the continuous slump in S&P500 prices, which is our market proxy. We expect Crisis to negatively affect the dependent variable.

Some key statistics for the variables used in the analyses are provided below. The T-test is based on the null hypothesis of the zero mean for the variable. At a 5% significance level only means of profit margin and S&P 500 return are statistically insignificant from zero.

Table 3. Descriptive statistics

Input variables	**Mean**	**Median**	**St.Dev**	**T-stat**
Return	0.0067	0.0129	0.0008	0
MCap	19513	3832.689	54481.93	0
PM	-4.2599	13.961	232.68	0.0992
PB	2.3521	1.9873	1.4729	0
FLev	2.2557	2.0464	1.3057	0
S&P 500	0.1169	0.0081	0.0455	0.1122
ER	-0.0009	0	0.0172	0
IR	0.0209	0.0235	0.0114	0
GDP	1.7962	2.25	2.547	0
Oil	0.0083	0.0207	0.09	0
Gas	-0.0054	0.0034	0.16	0.0024

The cross-correlation between the variables is summarized in the table below.

Table 4. Correlation table

	Ret	**MCap**	**PM**	**PB**	**FL**	**SP500**	**IR**	**GDP**	**Oil**	**Gas**
Ret	1									
MCap	0.005	1								
PM	0.021	0.025	1							
PB	0.121	0.015	0.030	1						
FL	0.001	-0.050	0.054	**0.307**	1					
SP500	**0.440**	0.012	0.004	0.041	-0.014	1				
IR	0.024	-0.031	-0.054	-0.141	0.018	0.024	1			
GDP	0.262	-0.013	-0.021	0.147	0.024	**0.348**	0.038	1		
Oil	**0.466**	0.006	-0.010	0.065	0.002	-0.220	-0.002	**0.310**	1	
Gas	**0.313**	0.007	-0.012	0.029	0.003	0.056	0.070	0.162	**0.334**	1

The highest correlation observed is between the sample returns and oil price (around 47%) and sample returns with market return (SP500 return) which is around 44%. Oil and gas returns correlation is at around 33%, which has declined considerably from the 20th century level. This can be explained by the excess supply of natural gas in the US, as pointed out by Ramberg and Parsons (2012).

Methodology

We start our analysis with estimating the pooled regression with the variables described above. There are two specifications for the pooled regression: one with the *Crisis* dummy variable and another without. This is done as an attempt to capture the sole effect of the 2008 financial crisis. An equation for the model without the *Crisis* dummy is provided below.

Pooled Regression Models

$$R_{i,t} = \alpha_i + \beta_M R_{M,t} + \beta_{oil} R_{oil,t} + \beta_{gas} R_{gas,t} + \beta_{Int} Int_t + \beta_{GDP} GDP_t + \beta_{ER} ER_t + \beta_{MCap} MCap_{i,t} + \beta_{PM} PM_{i,t} + \beta_{PB}\, PB_{i,t} + \beta_{FLev} FLev_{i,t} + \varepsilon_{i,t} \quad (1)$$

Index *i* indicates an individual company and *t* reflects the point in time. α_i is an intercept for each company and β's stand for sensitivity of stocks returns to the explanatory factors. $\varepsilon_{i,t}$ is an error term which is assumed to be white noise, i.e. normally distributed with zero mean and constant variance.

Second specification is identical to the first one, but it includes the *Crisis* dummy:

$$R_{i,t} = \alpha_i + \beta_M R_{M,t} + \beta_{oil} R_{oil,t} + \beta_{gas} R_{gas,t} + \beta_{Int} Int_t + \beta_{GDP} GDP_t + \beta_{ER} ER_t + \beta_{MCap} MCap_{i,t} + \beta_{PM} PM_{i,t} + \beta_{PB}\, PB_{i,t} + \beta_{FLev} FLev_{i,t} + Crisis_t + \varepsilon_{i,t} \quad (2)$$

To control for time effect we include 12 dummy variables for each year of the analysis, starting from 2001 to 2013 except for 2005 (to avoid the dummy variable trap). These dummies are added to specification (1):

$$R_{i,t} = \alpha_i + \beta_M R_{M,t} + \beta_{oil} R_{oil,t} + \beta_{gas} R_{gas,t} + \beta_{Int} Int_t + \beta_{GDP} GDP_t + \beta_{ER} ER_t + \beta_{MCap} MCap_{i,t} + \beta_{PM} PM_{i,t} + \beta_{PB}\, PB_{i,t} + \beta_{FLev} FLev_{i,t} + D_{2001} + \cdots + D_{2004} + + D_{2006} + \cdots + D_{2013} + \varepsilon_{i,t} \quad (3)$$

Another point of interest of this paper is whether companies in the sample hedge their exposure to changing oil and gas prices. To test this, the returns on oil and gas are split into positive and negative returns, creating two variables for each commodity's price. For instance, $R^{+}_{oil,t}$ in (2) contains the return on oil, $R_{oil,t}$ from (1), only for the time points *t* when $R_{oil,t}$ was positive. For all the other periods *t* when the return was negative, $R^{+}_{oil,t}$ takes the value of zero. $R^{-}_{oil,t}$ respectively consists of negative returns and zeros. $R^{+}_{gas,t}$ and $R^{-}_{gas,t}$ are constructed in the similar manner for the gas price. This is reflected in the specification below.

$$R_{i,t} = \alpha_i + \beta_M R_{M,t} + \beta_{Int} Int_t + \beta_{GDP} GDP_t + \beta_{ER} ER_t + \beta_{MCap} MCap_{i,t} + \beta_{PM} PM_{i,t} + \beta_{PB}\, PB_{i,t} + \beta_{FLev} MCap_{i,t} + +Crisis_t + \gamma^+ R^+_{oil,t} + \gamma^- R^-_{oil,t} + \delta^+ R^+_{gas,t} + \delta^- R^-_{gas,t} + \varepsilon_{i,t} \quad (4)$$

If $\gamma^+$and δ^+ are positive and significant, while γ^- and δ^- are insignificant, we believe that companies are hedging by entering long positions in oil and gas price options, respectively.

If γ^+ and γ^- , as well as γ^+ and δ^- are all positive and significant, we assume that companies in our sample do not engage in hedging strategies.

Next, it is not unreasonable to assume that companies have some unique time-invariant characteristics that are not measured by the above mentioned explanatory variables, but are correlated with them. This leads to the next specification that we estimate: the model with Fixed Effects. In the pooled regression model above α_i is an unknown constant, which is unique for every company. It captures the individual effect of omitted variables for each company, which is an implicit assumption of the Fixed Effects model. This individual effect is removed by the within-groups method by first calculating the averages for each variable in the pooled regression (1) above, including the dependent variable and the error term, and second, subtracting the averages from the original variables. The specification is provided below.

Fixed Effect Models

$$R_{i,t} - \bar{R}_i = (\alpha_i - \bar{\alpha}) + \beta_M(R_{M,t} - \bar{R}_M) + \beta_{oil}(R_{oil,t} - \bar{R}_{oil}) + \beta_{gas}(R_{gas,t} - \bar{R}_{gas}) + \beta_{Int}(Int_t - \overline{Int}) + \beta_{GDP}(GDP_t - \overline{GDP}) + \beta_{ER}(ER_t - \overline{ER}) + \beta_{MCap}(MCap_{i,t} - \overline{MCap_\iota}) + \beta_{PM}(PM_{i,t} - \overline{PM}_i) + \beta_{PB}\,(PB_{i,t} - \overline{PB}_i) + \beta_{FLev}(MCap_{i,t} - \overline{MCap}_i) + Crisis_t + (\varepsilon_{i,t} - \bar{\varepsilon}_t) \quad (5)$$

$\alpha_i = \bar{\alpha}$, since we assume α_i to be constant over time, and therefore the model is estimated without an intercept.

This paper also investigates whether firms in the sample are involved in hedging as described in the model specification (2) above. A similar exercise is done for the Fixed Effects model by replacing oil and gas return with separate positive and negative return variables. This is done by subtracting the overall mean from the returns and then dividing them into $R^+_{oil,t}$ and $R^-_{oil,t}$ and $R^+_{gas,t}$ and $R^-_{gas,t}$ for oil and gas, respectively.

$$R_{i,t} - \bar{R}_i = \beta_M(R_{M,t} - \bar{R}_M) + \beta_{Int}(Int_t - \overline{Int}) + \beta_{GDP}(GDP_t - \overline{GDP}) + \beta_{ER}(ER_t - \overline{ER}) + \beta_{MCap}(MCap_{i,t} - \overline{MCap_i}) + \beta_{PM}(PM_{i,t} - \overline{PM}_i) + \beta_{PB}(PB_{i,t} - \overline{PB}_i) + \beta_{FLev}(MCap_{i,t} - \overline{MCap}_i + \gamma^+ R^+_{oil,t} + \gamma^- R^-_{oil,t} + \delta^+ R^+_{gas,t} + \delta^- R^-_{gas,t} + Crisis_t + (\varepsilon_{i,t} - \bar{\varepsilon}_t) \quad (6)$$

All the linear models described above are estimated by using Ordinary Least Squares (OLS) method. The MATLAB code used to perform the analysis in enclosed in the Appendix.

Next section proceeds to the analysis of the results.

IV. Empirical Results

The first model that we estimated is represented with regression (1) above.

Table 5. Estimation results for Pooled Regression models

	Pooled Regression (1)		**Pooled with Crisis Dummy (2)**		**Pooled with Dummy Years (3)**	
	Beta	**P-Value**	**Beta**	**P-Value**	**Beta**	**P-Value**
Alpha	-0.0132***	0	-0.0107***	0.001	-0.0209***	0
MCap	0	0.7153	0	0.7367	0	0.8388
PM	0.0000133***	0.003	0.0000134**	0.0026	0.000014***	0.0019
PB	0.0069***	0	0.0071***	0	0.0069***	0
FLev	-0.0021**	0.0108	-0.002257***	0.007	-0.0026***	0.002
S&P500	0.7734***	0	0.7796***	0	0.8102***	0
IR	0.1898*	0.0409	0.3060***	0.0015	-0.2880	0.1661
ER	-0.6683***	0	-0.6723***	0	-0.6489***	0
GDP	0.0007	0.15	-0.0011***	0.067	0.002***	0.0006
Oil	0.3601***	0	0.3607***	0	0.3534***	0

Gas	0.1364***	0	0.1327***	0	0.1427***	0
Crisis	-	-	-0.0246***	0	-	-
R-Sq	0.3659		0.3676		0.3735	

*** - significant at 1% significance level. Based on a two-sided t-test.

** - significant at 5% significance level. Based on a two-sided t-test.

Table 6. Estimation results for the model with Fixed Effects

	Fixed Effects (5)	
	Beta	**P-Value**
Alpha	2.39E-03	0.0831
MCap	0.0029	0.0974
PM	0.0000177***	0.00003
PB	0.00982***	0
FLev	-0.0034***	0.0025
S&P500	0.9809***	0
IR	0.0049***	0.00012
ER	-0.0440***	0
GDP	-0.0027***	0.0110
Oil	0.344***	**0**
Gas	0.142***	**0**
Crisis	-0.0310***	**0**

R-Sq	0.3717

The results for the Fixed Effect model are discussed below

Market Capitalization turns out to be insignificant, meaning that returns cannot be explained by size of the company expressed in terms of capitalization.

Profit margin and price to book ratio are both found to be positive and significant at 1% significance level. An increase of price to book ratio by 1 will cause a 0.009% increase in return, and increase in profit margin by 1% will cause the return to increase by 0.0000177%, which is indeed small, but statistically significant. The positive relationships between profit margins and returns confirms the hypothesis of more profitable companies bringing higher rates of return on their stocks. Companies with higher price to book ratios are also found to have higher rates of return on their stocks. Average price to book in our sample in 2.35, meaning that on average, throughout the years, the price of a representative stock from our sample is 2.35 times as much as its book value. This supports the view that higher growth potential and overall optimism associated with company's future performance translates in higher returns on its stock as well.

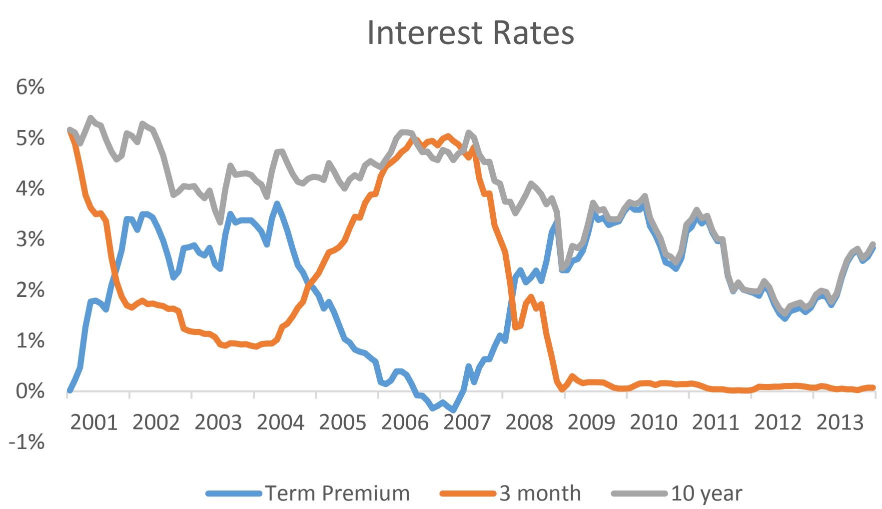
Financial leverage is estimated to have a negative and significant coefficient. This result illustrates that market perceives higher level of book leverage to be an ineffective mechanism to control the management, since higher levels of debt have a negative impact on firm performance. This is consistent with the literature discussed above.

Not surprisingly market return is significant in explaining stock returns and has quite a large effect on returns. A 1% increase in market return on average causes the individual stocks' return to increase by 0.98% when measured by the fixed effects model. In other words, an average β (beta) for oil and gas companies in the sample is 0.98, which is very close to the marker beta of 1. Sadorsky (2001) found that the average beta for oil and gas companies for the period of 1983 to 1999 to be around 0.78. Our pooled regressions estimation results return the betas of around 0.77 to 0.80 depending on the specification. This is perfectly in line with findings of Sadorsky. Fixed effects model implies that in the recent years (2001-2013) oil and gas stocks started to move more closely (almost perfectly) with the market and that correlations has gone up comparing to the results described in the 2001 paper by Sadorsky. Our analysis of a *simple* market model returns an average beta is 1.08, which implies that oil and gas stocks are on average more risky that the market, when it is used as the only explanatory variable. However once we include oil and gas returns, the sensitivity of returns to the market goes down to 0.77. Speaking about oil and gas returns, the relationship of both with stock returns were positive, as was expected. The return sensitivities on oil and gas are found to be 0.344 and 0.142 respectively. With 1% increase in oil return, return on stocks in the sample would on average increase by around 0.344%, and with a 1% increase in return on gas, the return on stocks in the sample would increase by 0.142% on average. Both coefficients are significant at 1% significance level. Oil beta in Sadorsky (2001) was estimated to be 0.31, which is slightly lower than our results, implying that our sample of returns is more dependent on oil returns.

Term Premium is found to be positively related to returns. However in the model specification with dummy variables for years, interest rate is found to be insignificant, possibly identifying that positive relationship in other model specifications is explained by time effect rather than term premium itself. The effect of interest rates is relatively small comparing to that of oil and gas prices. In fact, Park and Ratti (2008) show that impact of oil prices on stock returns is greater than that of interest rates even for non-oil and gas stocks also in the US and European countries.

The two components of the term premium as well as the variable itself are depicted below.

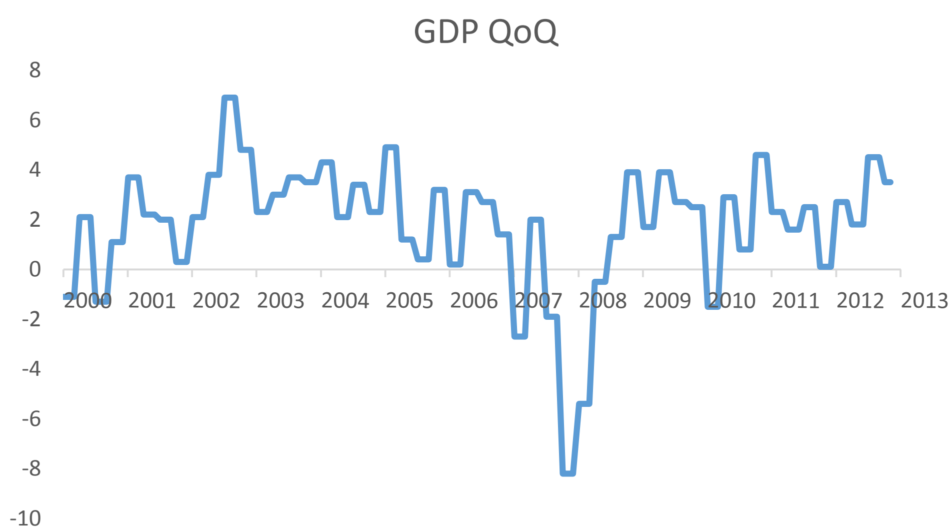
Graph 1.



One can see that the sharp decline in the term premium that started in 2004 and which continued all the way through early 2007 was mainly caused by a massive increase in short term interest rates (we use 3-month US T-bills). The spike in short term rates illustrates the increasing lack of liquidity that was followed by the credit crunch. This cause the term premium to become negative in late 2006 and early 2007. Short term interest rates have been found to be negatively related to stocks' returns in both Canada and the US as illustrated in Mittoo (1992). Therefore, since the short term interest rates are subtracted from long term to get the term premium in our analysis, the relationship changes its sign.

Next, GDP effect on oil and gas stocks' return is found to be negative. This can be justified by the fact that oil and gas stocks' prices tend to move with commodity cycle rather than business cycle. Another issue might be the frequency of the GDP data, since it is quarterly and the returns data is monthly, the relationship might not be captured precisely. The GDP growth used in this analyses is depicted below.

Graph 2.



Crisis of 2008 was found to decrease returns by 0.03% on average (1% level significance) and is in line with our expectations. The coefficient is smaller than one would have expected, but the pure of effect of Crisis variable is diluted by the market return, which definitely absorbs some of the effect of the crisis on the sample return.

The negative and consistently significant coefficient for the exchange rate (defined as growth rate of CAD/USD), contradicts our expectations of positive relationship between the exchange rate and the return on Canadian oil and gas companies. We expect the depreciation of Canadian dollar to positively affect the revenues of Canadian oil and gas companies (as Canada is the net exporter of oil and gas to US, with up to 97% of Canadian oil exports directed to the United States in 2013 (US Energy Information Administration). Previous research on this issue suggest that as a result of depreciation of CAD costs of Canadian companies increase more than revenues, because Canadian oil and gas companies are next importer of machinery and equipment from the US (Sadorsky, 2001).

Next, the analysis for hedging was performed.

Table 7. Estimation results for models with hedging

	Pooled Regression (4)		**Fixed Effects (6)**	
	Beta	**P-Value**	**Beta**	**P-Value**
Alpha	-0.0131***	0.0006	-0.00014	0.9467
MCap	-0	0.74409	-0.00215	0.111
PM	0.0000135**	0.0025	0.00002***	0
PB	0.0071***	0	0.0116***	0
FLev	-0.0023**	0.0068	-0.0037***	0.002494
S&P500	0.7859***	0	0.7914***	0
IR	0.3088***	0.0016	0.3785***	0.00018
ER	-0.6676***	0	-0.6682***	0

GDP	-0.0011	0.0648	-0.0015**	0.0103
Oil+	0.3957***	0	0.3989***	0
Oil-	0.3299***	0	0.3289***	0
Gas+	0.1326***	0	0.1297***	0
Gas-	0.1296***	0	0.1329***	0
Dummy Crisis	-0.0271***	0	-0.0276***	0
R-squared	0.3678		0.3719	

Betas for negative and positive returns on oil and gas are positive and significant, which identifies that companies are affected by both increases and decreases in oil and gas prices. Interestingly enough, both specifications estimated above indicate that companies in the sample are slightly more sensitive to the positive increase in oil returns than to negative. Returns go up by 0.39% on average when the price of oil increases by 1%, but they only go down by around 0.33% on average when the price of oil goes down by 1%. There is no such asymmetry for changes in gas price. Overall, our finding suggest that companies in the sample do not hedge. Moreover, the relationship between stocks' returns are hedging is found to be non-linear, according to Jin and Jorion (2006). They also find that when the oil and gas returns fall, firms' stocks' values do not follow directly, implying that if the hedging was present in sample, the coefficients for $R^{-}_{oil,t}$ and $R^{-}_{gas,t}$ would not be significant. Moreover, there is a little chance to discover the hedging relationships by using linear regression models to capture the non-linear relationships.

V. Conclusion

This paper has investigated the effects of macro and micro variables on the returns of oil and gas companies stocks in the US and Canada for the period from 2001 to 2013. Among variables that have been used in research before, we investigate the effects of 2008 -2009 Financial Crisis and whether the companies in the sample implement hedging strategies.

Our research finds that among firm specific characteristics, variables such as profit margin, price to book ratio and degree of financial leverage are significant in explaining the return on stocks in the sample, while market capitalization is not significant. Higher profit margin and price to book ratio are found to positively affect the returns, which is in line with our expectations. Higher book financial leverage, on the contrary, leads to lower returns, identifying the higher degree of cautiousness associated with the stock. Market capitalization is found to be insignificant, which has been the case in other studies.

Among the macro variables, return on a market portfolio (estimated with S&P 500), interest rates, GDP growth, returns on oil and gas and Crisis are all found to be statistically significant in explaining the returns on oil and gas companies' stocks. For Canadian companies' stocks the exchange rate between USD and CAD is also found to be significant. No evidence of hedging against oil and gas price fluctuations has been identified in the sample. It needs to be noticed that the relationship between hedging and stocks' returns has been found to be non-linear by previous researches, therefore the present analysis could be improved by using more suited econometrics techniques to estimate the non-linear effects of hedging. In line with our expectations, market return as well as returns on oil and gas have been found to have positive and large significant effect on the returns of stocks in the sample. Interest rate, or the term premium, is also positively related with the returns on oil and gas stocks. Crisis of 2008-2009 caused the decrease in returns on oil and gas companies as had been expected. Finally, the CAD/USD exchange rate was found to negatively affect the returns on Canadian oil and gas stocks, which has been also discovered by Sadorsky (2001) and Boyer and Filion (2004). Their papers suggest that a possible explanation is that Canadian companies are net importers of capital and machinery from the US, hence the rising exchange rate drives up the costs more than it does the revenues. This is one of the interesting ideas for future research.

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Appendices

Appendix 1

List of Canadian based companies:

Company	Market Capitalisation
Advantage Oil & Gas Ltd.	867.6242
Arc Resources	8608.072
Bonterra Energy Corp.	1392.945
Bellatrix Exploration Ltd.	892.5636
Canacol Energy Ltd	296.4898
Canadian Natural Resources Ltd.	41422.22
Canadian Oil Sands Ltd.	7046.234
Encana Corporation	13353.07
Enerplus	3048.641
Freehold Royalties Ltd	1439.7
Husky Energy Inc.	23786.79
Imperial Oil Ltd	42023.96
Niko Resources Ltd	24.44498
Precision Drilling Corporation	2172.416
Peyto Exploration&Development Corp	5160.937
Penn West Petroleum Ltd	2024.093
Suncor Energy Inc.	52409.16
Trican Well Service Ltd	1159.826
Talisman Energy Inc	5647.105

List of the US based companies:

Company	Market Capitalisation
Apache Corp	24128.72
Anadarko Petroleum Corp	40085.51
Atwood Oceanics Inc	2065.23
Chesapeake Energy Corp	13475.13
Consol Energy	9006.92
Cabot Oil & Gas Corporation	13646.16
Conocophillips	81326.33
Comstock Resources Inc.	424.04
Carrizo Oil & Gas Inc.	1818.96
Chevron Corporation	205810.30
Clayton Williams Energy Inc.	705.10
Denbury Resources Inc.	2912.16
Diamond Offshore Drilling Inc.	4028.03
Devon Energy Corp	24124.60
Eog Resources Inc.	47523.33
Gulfport Energy Corp.	4082.41
Hess Corporation	21803.76
Helmerich & Payne, Inc.	7529.23
Marathon Oil Corporation	19518.00
Murphy Oil	8594.29

Noble Energy, Inc.	17796.09
Newfield Exploration Co	3736.75
Occidental Petroleum Corp	61855.84
Pdc Energy, Inc.	1058.71
Patterson Uti Energy Inc.	2590.04
Penn Virginia Corp	367.10
Pioneer Natural Resources Co	21326.62
Range Resources Corp	11075.20
Stone Energy Corp	887.57
Sm Energy Company	2928.76
Unit Corp	1894.72
Exxon Mobil Corp	383393.84

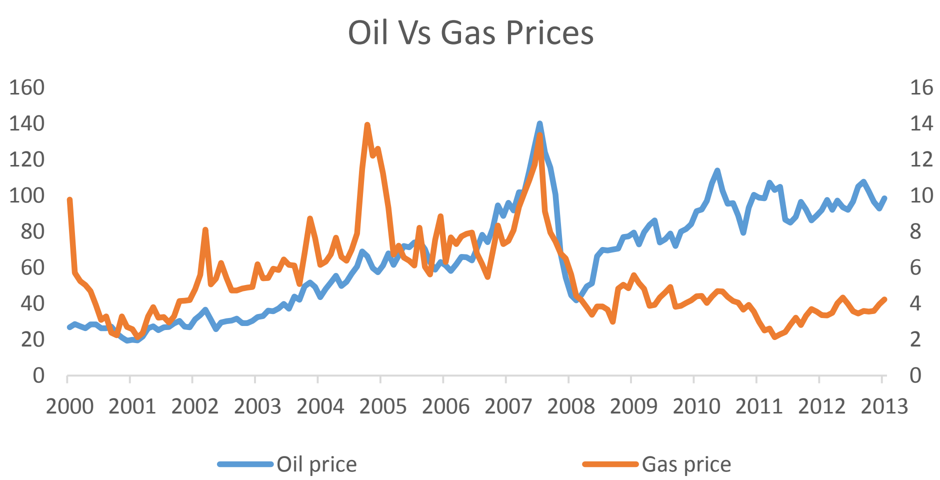
Appendix 2

Simple Market model output

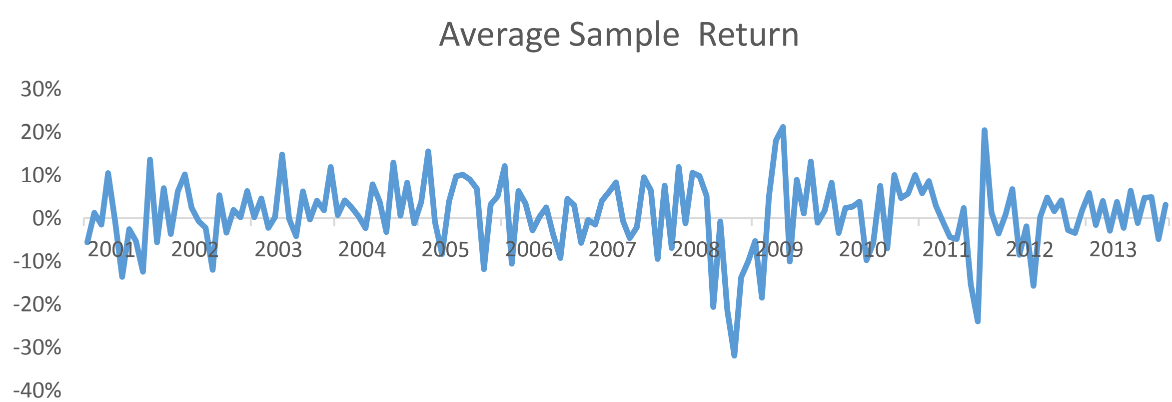
Beta	1.0827
P-Value	0

Appendix 3

Oil Vs Gas Price (2000 To 2013)



Appendix 4



Appendix 5

```
% Code for the final project BUS 870

% Determinants of Returns for the North American Oil & Gas sector: A macro
% and micro analysis

% Authors: Anastasia Lavrik
%          Dummy Padmesh
% Date: 12-11-2014

% Project Supervisor: Christina Atanasova
%
clc
clear
close all

%% Data Collection & Organisation
% Import the company stock, risk-free rates & market proxy price data
[Prices] = xlsread('FinalData','Prices','B2:BA158');
[Market]=xlsread('FinalData','SP500','B2:B158');

[RF]=xlsread('FinalData','IntR','F3:F158');

% Import macro factors data and organise data in a uniform vector
[OilPrice]=xlsread('FinalData','OilPrice','B2:B158');
[GasPrice]=xlsread('FinalData','GasPrice','B2:B158');
[Inf]=xlsread('FinalData','Inf','B2:B158');
Inf2=repmat(Inf,1,52);
Inflation=Inf2(:);
[ER]=xlsread('FinalData','ER','B2:BA158');
rate=ER(:);

[IntR]=xlsread('FinalData','IntR','D2:D158');
IntR2=repmat(IntR,1,52);
IR=IntR2(:);
[GDP]=xlsread('FinalData','GDP','B2:B158');
GDP2=repmat(GDP,1,52);
RGDP=GDP2(:);
% Import company specific variables(micro variables)
[MCap]=xlsread('FinalData','Mktcap','B2:BA158');
MC=MCap(:);
[PB]=xlsread('FinalData','PB','B2:BA158');
PtoB=PB(:);
[FLev]=xlsread('FinalData','FLev','B14:BA169');
FL=FLev(:);
[PM]=xlsread('FinalData','PM','B2:BA158');
ProfM=PM(:);

% Calculate the Log Returns
LogReturn=log(Prices(2:end,:))-log(Prices(1:end-1,:));
%convert risk-free to percentage

RF2 = repmat(RF,1,52);
```

```
%calculate excess return
LogExretmat=LogReturn-RF2;
LogExret=LogExretmat(:);
LogMarketReturn=log(Market(2:end,:))-log(Market(1:end-1,:));
LogMarketExRetmat=LogMarketReturn-RF;
LogMarketExRetmat2=repmat(LogMarketExRetmat,1,52);
LogMarketExRet=LogMarketExRetmat2(:);
LogOilReturn=log(OilPrice(2:end,:))-log(OilPrice(1:end-1,:));
LogGasReturn=log(GasPrice(2:end,:))-log(GasPrice(1:end-1,:));
op2= repmat(LogOilReturn,1,52);
op=op2(:);
gp2= repmat(LogGasReturn,1,52);
gp=gp2(:);
LogMCap= log(MCap);

%Add dummy variables for each year from 2001 to 2013
[D1]=xlsread('FinalData','Dummy','B2:B157');
D1= repmat(D1,1,52);
D1=D1(:);
[D2]=xlsread('FinalData','Dummy','C2:C157');
D2= repmat(D2,1,52);
D2=D2(:);
[D3]=xlsread('FinalData','Dummy','D2:D157');
D3= repmat(D3,1,52);
D3=D3(:);
[D4]=xlsread('FinalData','Dummy','E2:E157');
D4= repmat(D4,1,52);
D4=D4(:);
[D5]=xlsread('FinalData','Dummy','F2:F157');
D5= repmat(D5,1,52);
D5=D5(:);
[D6]=xlsread('FinalData','Dummy','G2:G157');
D6= repmat(D6,1,52);
D6=D6(:);
[D7]=xlsread('FinalData','Dummy','H2:H158');
D7= repmat(D7,1,52);
D7=D7(:);
[D8]=xlsread('FinalData','Dummy','I2:I157');
D8= repmat(D8,1,52);
D8=D8(:);
[D9]=xlsread('FinalData','Dummy','J2:J157');
D9= repmat(D9,1,52);
D9=D9(:);
[D10]=xlsread('FinalData','Dummy','K2:K157');
D10= repmat(D10,1,52);
D10=D10(:);
[D11]=xlsread('FinalData','Dummy','L2:L157');
D11= repmat(D11,1,52);
D11=D11(:);
[D12]=xlsread('FinalData','Dummy','M2:M157');
D12= repmat(D12,1,52);
D12=D12(:);
[D13]=xlsread('FinalData','Dummy','N2:N157');
D13= repmat(D13,1,52);
D13=D13(:);
[DFC]=xlsread('FinalData','Dummy','O2:O157');
```

```
% DV=[D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12];

%Adding dummy variable for the 2008 financial crisis(July2008to June 2009)
DFC= repmat(DFC,1,52);
DFC=DFC(:);


%% Analysing company Data & inputs

% We determine mean, median and standard deviation of inputs

% For logreturns

MktRet_mean=mean(LogMarketReturn);
MktRet_sd=std(LogMarketReturn);
%Excess return ( Logreturn - Risk free)
ER_mean=mean(LogExret);
ER_sd=std(LogExret);
ERMkt_mean=mean(LogMarketExRet);
ERMkt_sd=std(LogMarketExRet);
Macro_Mean=[mean(RGDP) mean(IR) mean(rate)];
Macro_std=[std(RGDP) std(IR) std(rate)];
Micro_Mean=[mean(MCap(:)) mean(FL) mean(PtoB) mean(ProfM)];
Micro_std=[std(MCap(:)) std(FL) std(PtoB) std(ProfM)];
inp_Median=[median(LogExret),median(MCap(:)),median(ProfM),median(PtoB),media
n(FL),median(LogMarketExRet),median(rate),median(IR),median(RGDP),median(LogO
ilReturn),median(LogGasReturn)];
Oil_mean=mean(LogOilReturn);
Oil_sd=std(LogOilReturn);
Gas_mean=mean(LogGasReturn);
Gas_sd=std(LogGasReturn);
% Number of companies
n=52;
% find t statistic
ttest(LogExret);
inp_tt=[ttest(LogExret),ttest(MCap(:)),ttest(ProfM),ttest(PtoB),ttest(FL),tte
st(LogMarketExRet),ttest(IR),ttest(RGDP),ttest(rate),ttest(op),ttest(gp)];

%Calculate correlations of input data
inp1=[LogExret,MC,ProfM,PtoB,FL,LogMarketExRet,IR,RGDP,op,gp];

    inp_corr=corrcoef(inp1);

% COrrelation of canadian firms with exchange rate

    [Can_Prices] = xlsread('FinalData','Output','A2:T158');
    LogCReturn=log(Can_Prices(2:end,:))-log(Can_Prices(1:end-1,:));
    LogCExretmat=LogCReturn-RF2(:,1:20);
LogCExret=LogCExretmat(:);
canexrate=ER(:,1);
cer=repmat(canexrate,1,20);
cer=cer(:);
corr(LogCExret,cer)
mean(PtoB)
```

```
%plot intrest rate term premiums
plot(IntR)

%% Regression for pooled data

% Model1: Pooled without dummy variables

results=regstats(LogExret,[MC,ProfM,PtoB,FL,LogMarketExRet,rate,IR,RGDP,op,gp
]);

% Model2: Pooled with time-series dummy variables

results2=regstats(LogExret,[MC,ProfM,PtoB,FL,LogMarketExRet,IR,rate,RGDP,op,g
p,...
        D1,D2,D3,D4,D5,D7,D8,D9,D10,D11,D12,D13]);
% Model3: Pooled with Crisis dummy variable

results3=regstats(LogExret,[MC,ProfM,PtoB,FL,LogMarketExRet,IR,rate,RGDP,op,g
p,...
        DFC]);

results7=regstats(LogExret,[LogMarketExRet]);

%% Fixed Effects Model

% find average values for fixed effects regression
for idx=1:n
avgret(idx)=mean(LogExretmat(:,idx));
avgmcap(idx)=mean(LogMCap(:,idx));
avgpm(idx)=mean(PM(:,idx));
avgpb(idx)=mean(PB(:,idx));
avgFLev(idx)=mean(FLev(:,idx));
end

%FE for macro variables
avgret=repmat(avgret,156,1);
FE_ret=LogExretmat-avgret;
FE(:,1)=FE_ret(:);

avgmcap=repmat(avgmcap,156,1);
FE_mc=LogMCap-avgmcap;
FE(:,2)=FE_mc(:);

avgpm=repmat(avgpm,156,1);
FE_pm=PM-avgpm;
FE(:,3)=FE_pm(:);

avgpb=repmat(avgpb,156,1);
FE_pb=PB-avgpb;
FE(:,4)=FE_pb(:);

avgFLev=repmat(avgFLev,156,1);
FE_fl=FLev-avgFLev;
FE(:,5)=FE_fl(:);
```

```
%FE for macro
FE_exret=LogMarketExRet-mean(LogMarketExRet);
FE_IR=IR-mean(IR);
%FE for exchange rate (remove zeros representing US companies )
FE_ER=NaN(8112,1);
for idx=1:length(FE)
if rate(idx,1)== 0
    FE_ER(idx,1)=rate(idx,1);
else
    FE_ER(idx,1)=rate(idx,1)-mean(ER(:,1));
end
end


FE_Inf=Inflation-mean(Inflation);
FE_GDP=RGDP-mean(RGDP);
FE_op=op-mean(op);
FE_gp=gp-mean(gp);

FE(:,6)=FE_exret(:);
FE(:,7)=FE_IR(:);
FE(:,8)=FE_ER(:);
FE(:,10)=FE_GDP(:);
FE(:,11)=FE_op(:);
FE(:,12)=FE_gp(:);

HFE_op=NaN(8112,1);
HFE_on=NaN(8112,1);
HFE_gp=NaN(8112,1);
HFE_gn=NaN(8112,1);
%Fixed effects for hedging
for idx =1:length(FE)
if FE(idx,11) > 0

    HFE_op(idx)=FE(idx,11);
    HFE_on(idx)=0;

else
     HFE_op(idx)=0;
     HFE_on(idx)=FE(idx,11);
end
 end

for idx =1:length(FE)
if FE(idx,12) > 0

    HFE_gp(idx)=FE(idx,12);
    HFE_gn(idx)=0;

else
     HFE_gp(idx)=0;
     HFE_gn(idx)=FE(idx,12);
end
```

```
end

% Model 4: FIXED EFFECTS REGRESSION results
results4=regstats(FE(:,1),[FE(:,3),FE(:,4),FE(:,5),FE(:,6),FE(:,7),FE(:,8),FE
(:,10),FE(:,11),FE(:,12),DFC]);
results6=regstats(FE(:,1),[FE(:,3),FE(:,4),FE(:,5),FE(:,6),FE(:,7),FE(:,8),FE
(:,10),HFE_op,HFE_on,...
    HFE_gp,HFE_gn,DFC]);

  %% HEDGING IN OIL&GAS SECTOR
 H_oilpost=NaN(156,1);
 H_oilneg=NaN(156,1);
% Seperate oil prices into positive and negative return vectors
for idx =1:156
if LogOilReturn(idx) > 0

    H_oilpost(idx)=LogOilReturn(idx);
    H_oilneg(idx)=0;

else
     H_oilpost(idx)=0;
     H_oilneg(idx)=LogOilReturn(idx);
end

end

% Input this into vectors with equal dimesions as other inputs
hop2= repmat(H_oilpost,1,52);
hedged_op_post=hop2(:);
hop2= repmat(H_oilneg,1,52);
hedged_op_neg=hop2(:);
% To check for hedging for gas prices
H_gp=NaN(156,1);
 H_gn=NaN(156,1);
% Seperate oil prices into positive and negative return vectors
for idx =1:156
if LogGasReturn(idx) > 0

    H_gp(idx)=LogGasReturn(idx);
    H_gn(idx)=0;
else
     H_gp(idx)=0;
     H_gn(idx)=LogGasReturn(idx);
end

end
 hgp2= repmat(H_gp,1,52);
hedged_gp_post=hgp2(:);
hgp2= repmat(H_gn,1,52);
hedged_gp_neg=hgp2(:);

% Model 5:Pooled data with crisis and hedging
results5=regstats(LogExret,[MC,ProfM,PtoB,FL,LogMarketExRet,IR,rate,RGDP,hedg
ed_op_post, hedged_op_neg,hedged_gp_post,hedged_gp_neg,DFC]);
```